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The Random Field Effect in an Aerosil Dispersion on Smectic A Ordering in 8OCB

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Introduction: We report x-ray diffraction studies of the nematic to smectic A transition in the liquid crystal 8OCB in an aerosil dispersion. Aerosils are 70Å diameter silica spheres covered with hydroxyl groups. They hydrogen bond together to form a porous random environment. We find that this environment effectively imposes a random pinning field on the liquid crystal.

Methods and Materials: 8OCB was studied in seven different densities of aerosil in the temperature range 80°C to 40°C. The development of order was studied using small-angle x-ray diffraction.

Results: Being able to measure the scattering line-shape more than 35°C below the nematic to smectic A transition has been highly important in resolving ambiguities in the data analysis which troubled previous studies. The smectic A order in the porous medium is characterized by a finite correlation length which is approximately inversely proportional to the silica surface area. This behavior helps us understand the relationship between this system and the well known random field problem.

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